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BIO 125

9/1/23

LABORATORY 2: MOLECULAR ACTIVITY AND MEMBRANE TRANSPORT

PURPOSE:

The purpose of lab 2: Molecular Activity and Membrane Transport, was to explore and understand the basic concepts and properties of passive transport such as diffusion, osmosis, and differential permeability as well as the concept of filtration and the effects cells have from tonicity.

PROCEDURE:

2-B: Measurement of diffusion through a liquid

- Three Petri dishes were filled with 40 mL of 25˚C water
- In each dish, one crystal of potassium permanganate was dropped
- After 5 minutes the largest diameter of the colored spot was measured
- These steps were repeated but for temperatures of 5˚C and 45˚C
- Using the results, graphs of ranges and means for each temperature were created to compare results

2-C: Measurement of diffusion through agar

- Taking 2 petri dishes filled with agar, 2 drops of methylene were placed in one dish and 2 drops of potassium permanganate were placed in the other dish
- The time and diameter of the spots were timed and measured immediately. After every minute for 10 minutes the diameter of the spots was measured in millimeters
- After a graph was created to compare the diffusion rates of both chemicals

2-D: Demonstration of filtration

- Taking 3 filter papers, they were made into cones and placed into 3 separate glass funnels
- Three 100-militer solutions of charcoal and water making a thick, medium thick, and thin solution were made then weighed to retrieve the mass of the charcoal used
- 50 mL of each solution were poured into the funnel one at a time then the number of drops per minute were counted, again when the funnel was half filled, then when it was nearly empty
- The procedure was repeated with the remaining 50 mL of each solution

2-F: Measurement of osmosis

- 2 dialysis bags were filled with sucrose solutions and attached securely to the bottom of 2 open, thin glass tubes. One bag being filled with 25% of the sucrose solution and the other 50%
- Both bags were inserted into separate beakers of distilled water ensuring that the dialysis bags were fully submersed but not touching the bottom of the beakers, each suspended by a ring clamp being applied to the glass tube
- The systems equilibrated for 5 minutes, then the fluid levels were marked and time was recorded
- Fluid levels were the measured every 10 minutes for 50 minutes
- The length was divided by the number of minutes to get the rate in mm/min
- The rate of osmosis for each system was determined

2-G: Measurement of differential permeability of sugar and starch

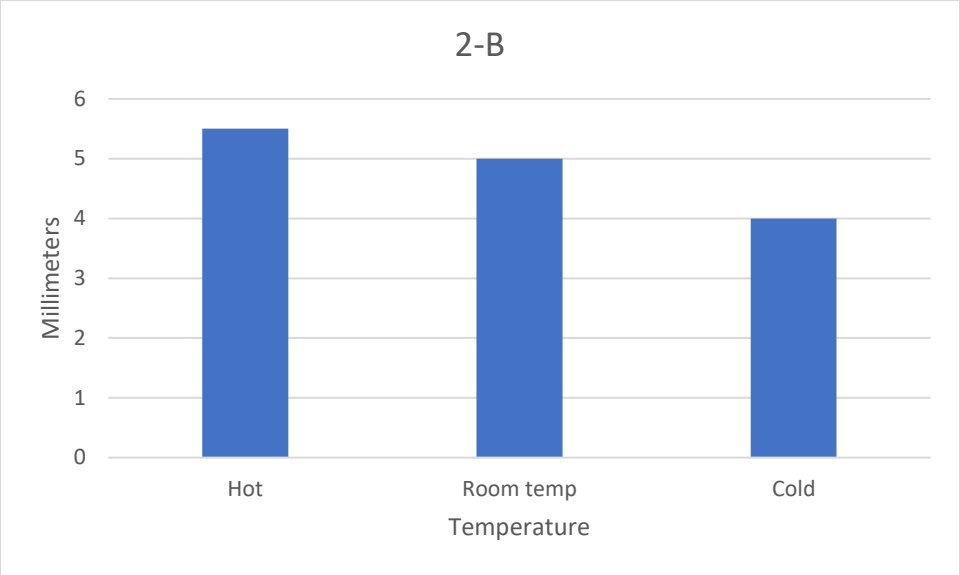
- A dialysis bag was filled with 1% starch-10% glucose solution
- The bag was tied to a glass rod and suspended in a beaker of distilled water
- After 15 minutes the water was checked for starch by adding 10 drops of Lugol's solution to 5 mL of water, red color indicated no starch and a navy blue indicated starch
- Sugar was tested by adding 3 mL of benedict's solution to 5 mL of water, simmering the solution for 5 minutes, a blue color indicated no sugar and a color change indicated sugar
- The water was tested again at 30, 45, and 60 minutes
- Results were recorded

2-H: The effects of tonicity on red blood cells (Demonstration)

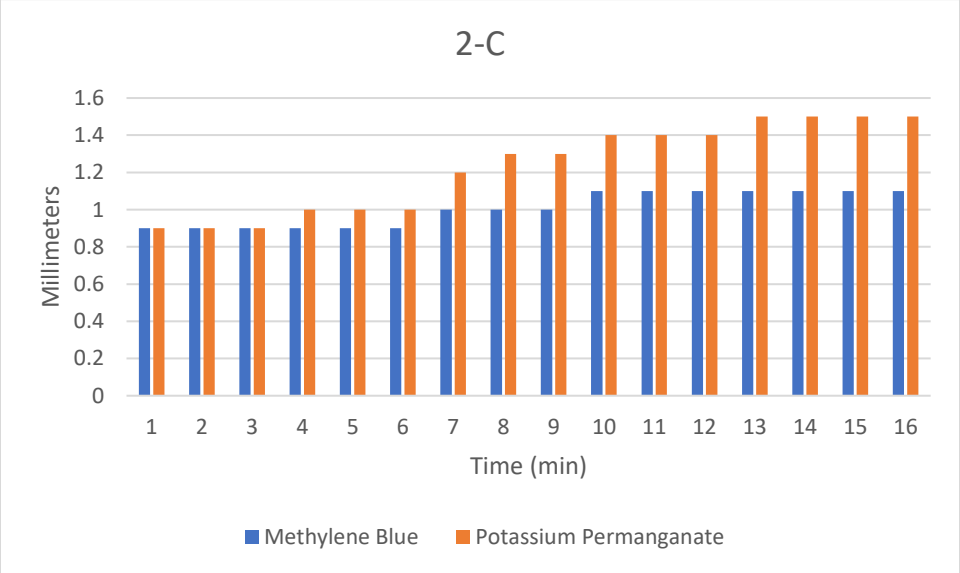
- One milliliter of distilled water, physiological saline, and salt water were separated into 3 test tubes
- A drop of blood was added to each tube and contents were mixed thoroughly
- A wet mound slide was made of each solution
- The following were observed: hemolysis of cells in hypotonic solution, maintenance of cell size in the isotonic solution, and crenation of cells in the hypertonic solution
- A drawing of each observation was made and an explanation

<u>RESULTS</u>:

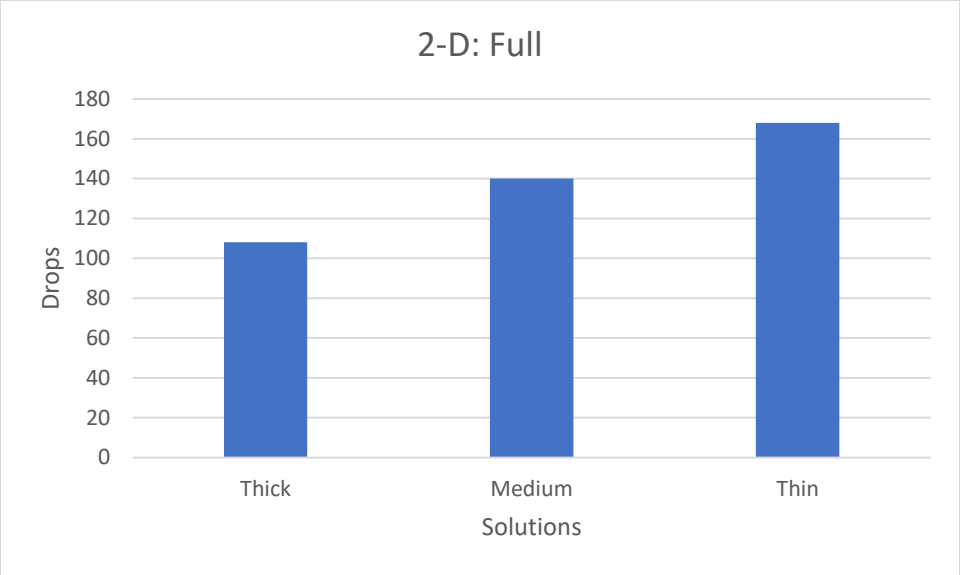
2-B: Measurement of diffusion through a liquid

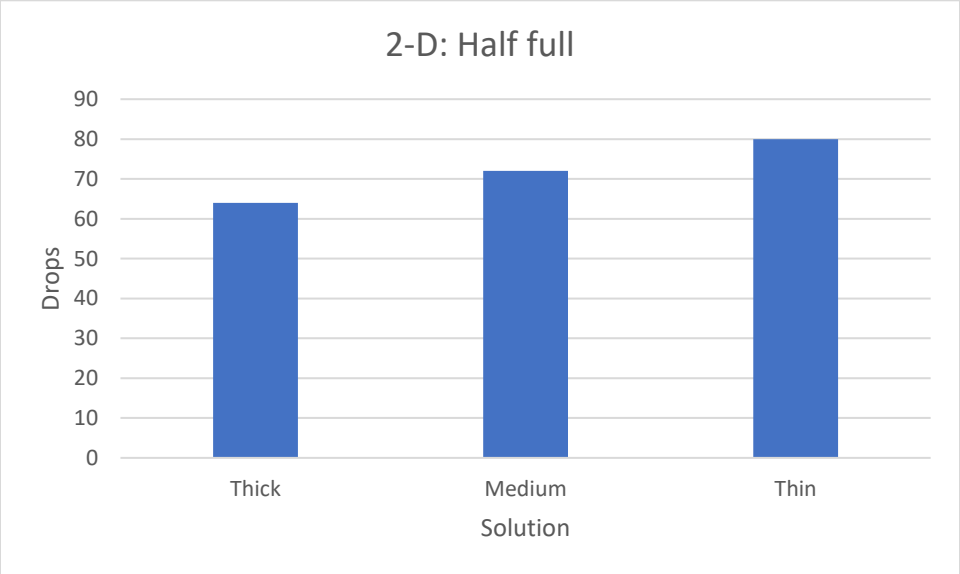


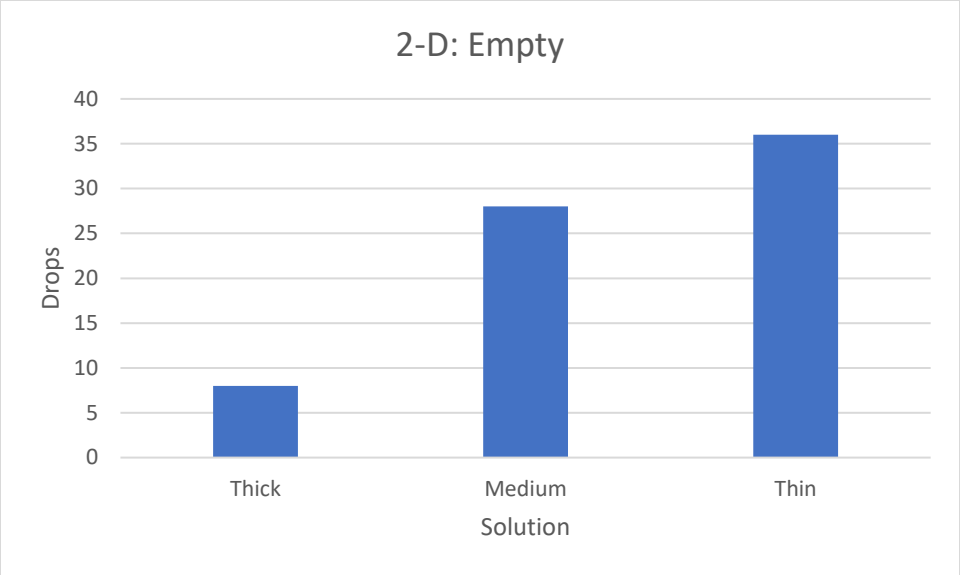
2-C: Measurement of diffusion through agar



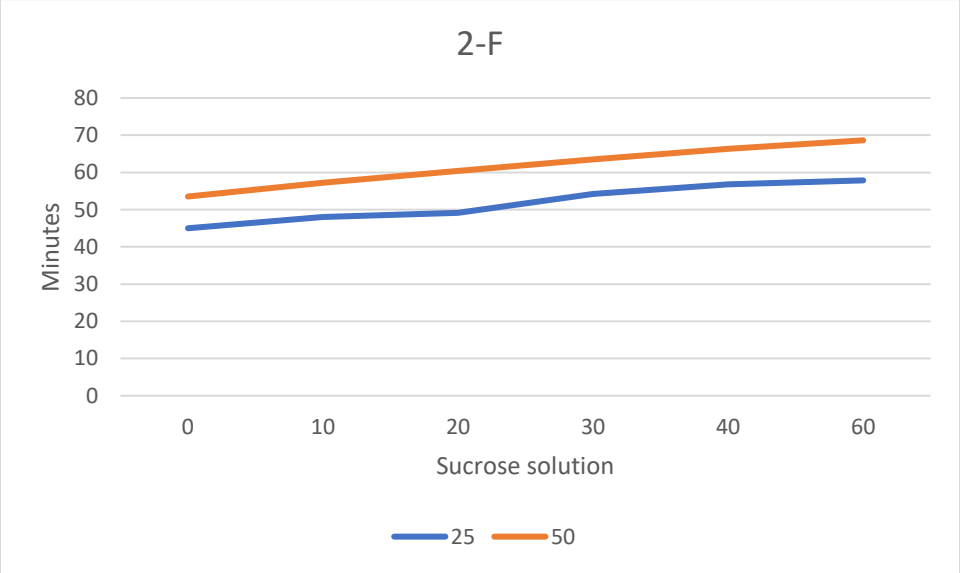
2-D: Demonstration of filtration


2-D: Full
180
160
140
120
100
80
60
40
20
0
Drops
Thick
Medium
Thin
Solutions


2-D: Half full
90
80
70
60
50
40
30
20
10
0
Drops
Thick
Medium
Thin
Solution



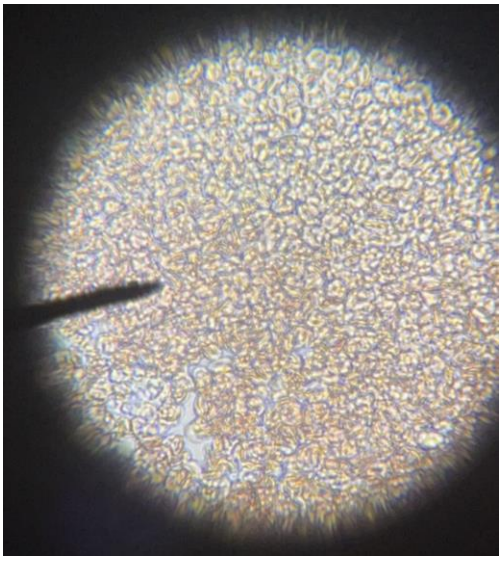
2-F: Measurement of osmosis

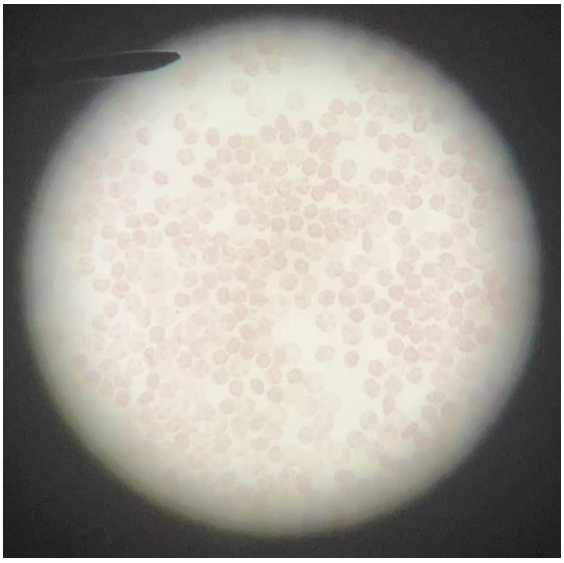


2-G: Measurement of differential permeability of sugar and starch

Time (min)	A	B
15	no starch	little sugar
30	no starch	moderate sugar
45	no starch	more sugar
60	no starch	lots of sugar

2-H: The effects of tonicity on red blood cells (Demonstration)

 Sodium 2%

 Sodium 5%


DI water

DISCUSSION:

2-B: Measurement of diffusion through a liquid

After looking at the results for this lab and comparing the difference between the different water temperatures it appears that the hot solution had the largest diameter over time while the cold solution had the smallest diameter this indicates that the hot solution had a faster rate of diffusion. Although I didn't perform this experiment I find the results interesting but if I were to make a hypothesis I would assume the hot solution would have the largest diameter.

2-C: Measurement of diffusion through agar

In this experiment, potassium permanganate had the largest diameter compared to methylene blue meaning it had the fastest diffusion rate. According to the Merck Index the molecular formula for methylene blue is $C_{16}H_{18}ClN_3S$ and the molecular formula for potassium permanganate is $KMnO_4$ according to the molecular formulas less elements are involved in potassium permanganate which perhaps can be the reason of a faster diffusion rate compared to methylene blue.

2-D: Demonstration of filtration

In this experiment, I found the results to be predictable due to knowing that a thinner solution would pass through a filter a lot easier than a thick solution and it shows in the graphs for each stage of filtration. Charcoal did not pass through the filter. I believe the most influential factor in filtration and the rate it occurs is how thick or thin a solution is. The thicker the solution the slower the rater of filtration will be as shown in the results of this lab.

2-F: Measurement of osmosis

I did not perform this experiment, however looking at the results that my peers were able to obtain it shows that the system with the fastest osmotic rate was the 50% sucrose solution meaning that the water molecules of this solution were able to move through the high concentration of water molecules to a lower concentration faster than the 25% sucrose solution. I can't say that I would have predicted this results but after looking at the data I do find it reasonable.

2-G: Measurement of differential permeability of sugar and starch

In this experiment, after 15 minutes there was no starch in the water and no sugar in the water. At 60 minutes there was still no starch and the solution was a reddish-brown color however there was a red color that indicated the presence of sugar. This indicates that as time passed sugar was able to escape into the water while the starch did not.

2-H: The effects of tonicity on red blood cells (Demonstration)

In this experiment, observation of blood in sodium 2%, sodium 5%, and DI water under a microscope occurred. In the sodium 2% solution I observed crenation of cells in the hypertonic solution because the blood cells appeared to have shrunk meaning the solute concentration inside the cell is lower. In the sodium 5% solution I observed hemolysis of cells in the hypotonic solution because it appears that the cells have swelled up and are enlarged meaning the solute concentration inside the cell is higher. In the DI water solution I observed maintenance of cell size in the isotonic solution because it was hard to see what was on the slide of this one but since there was no obvious change it means the solute concentration inside the cell is equivalent to the solution outside of the cell. Overall I thought this experiment was very fascinating due to being able to see the way the cells were able to react.

<u>CONCLUSION</u>:

After preforming these experiments and analyzing the date collected I am able to come to the conclusion that diffusion is temperature and size dependent because the experiments that had it involved did show that the hotter a solution was had a faster diffusion rate and larger diameter. Also a big factor of filtration rate is how dense the solution is, the thicker a solution is the slower it will filter. Osmosis is dependent on concentration for example in the last experiment the larger concentration caused more swelling compared to the solution with a smaller concentration. Overall I found that these experiments showed an accurate representation of how everything works.